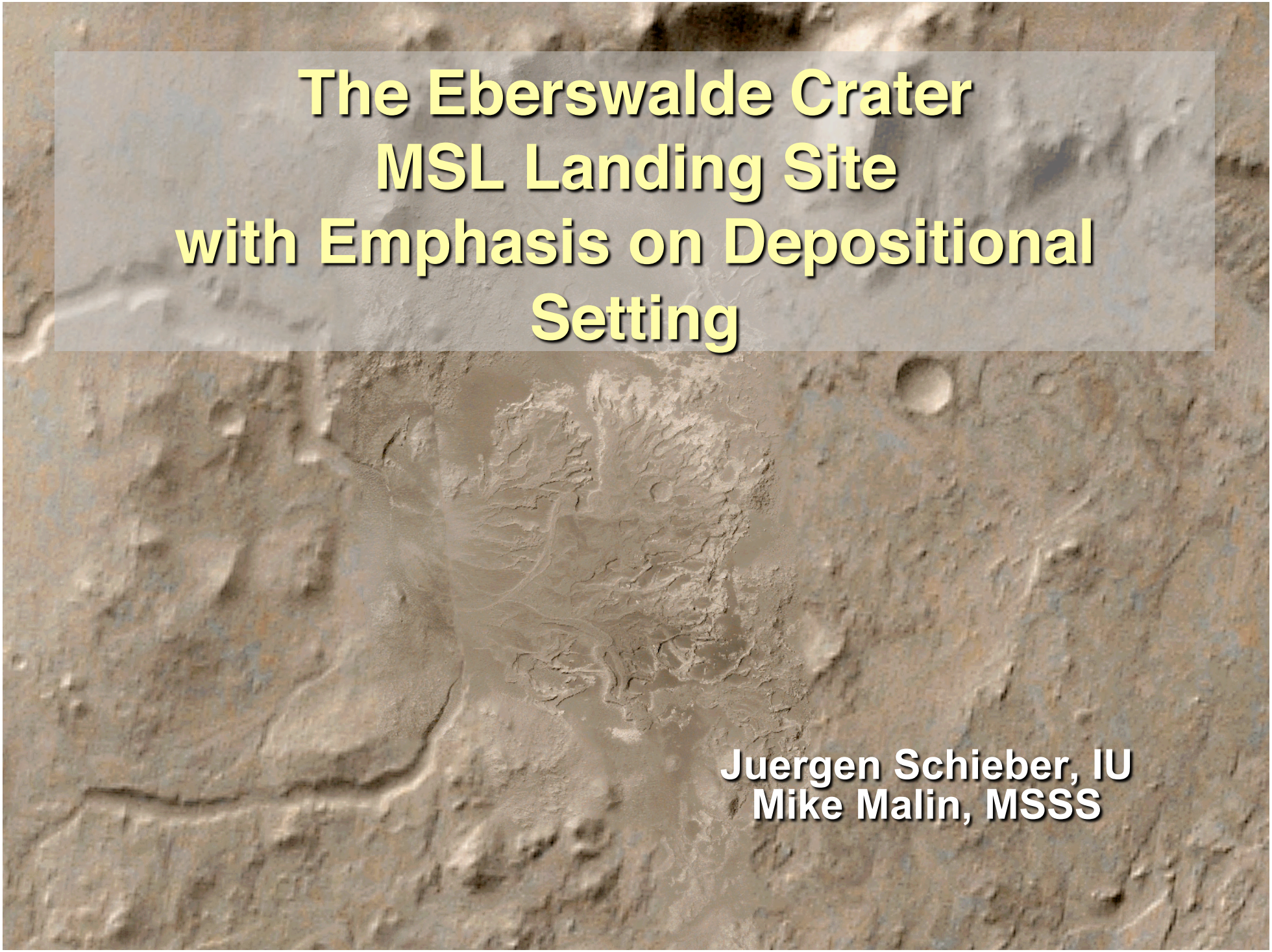
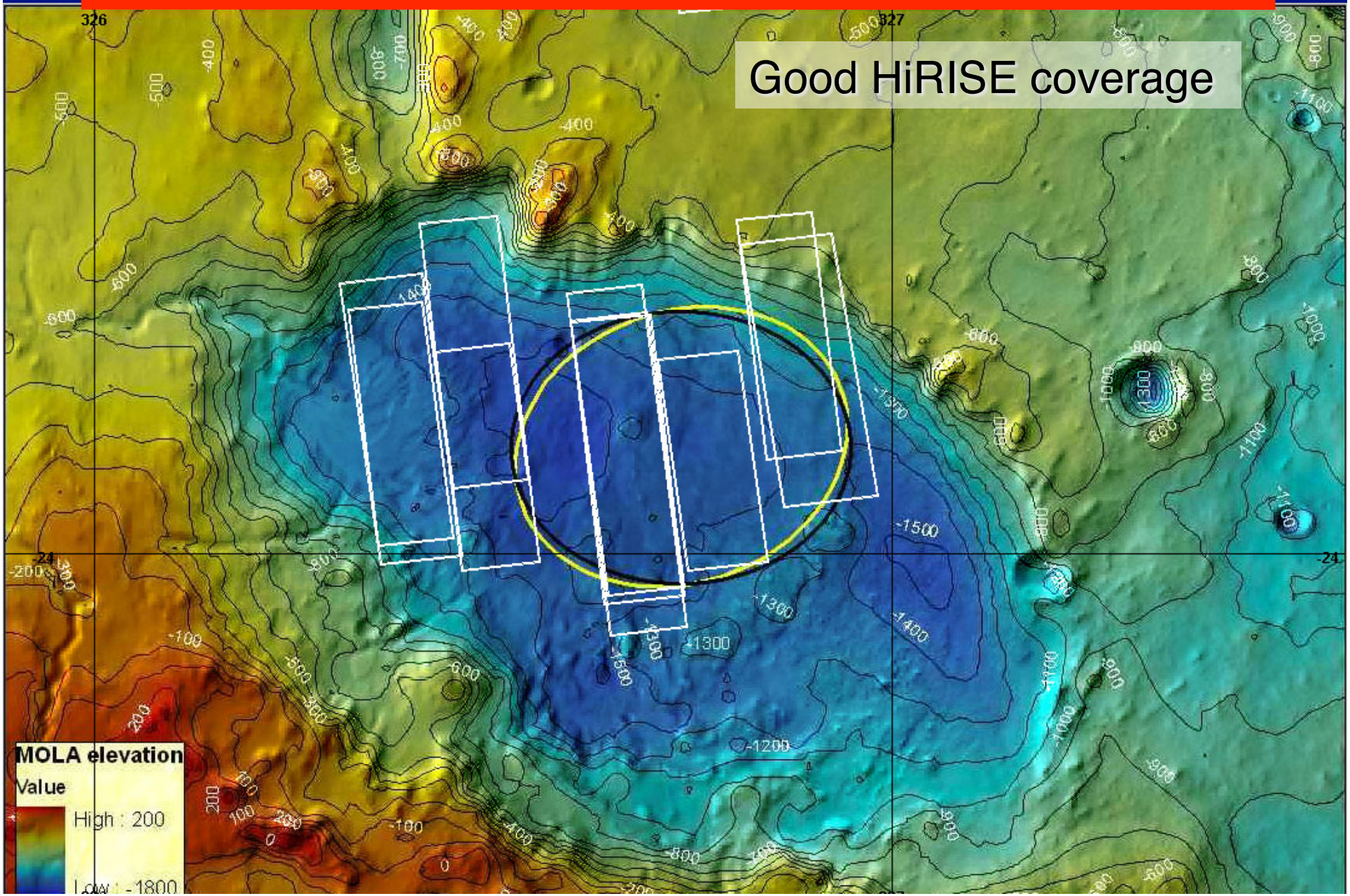
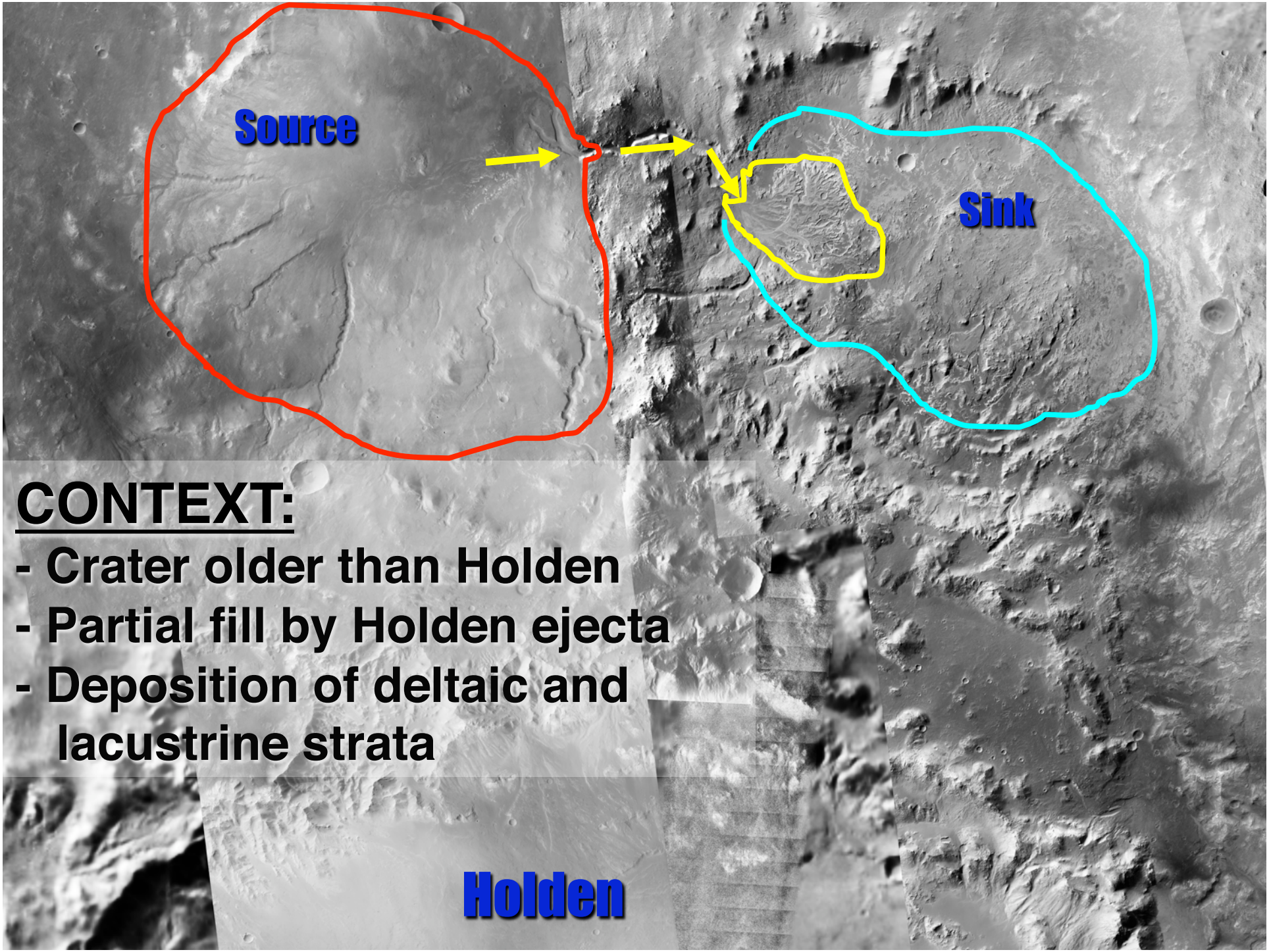


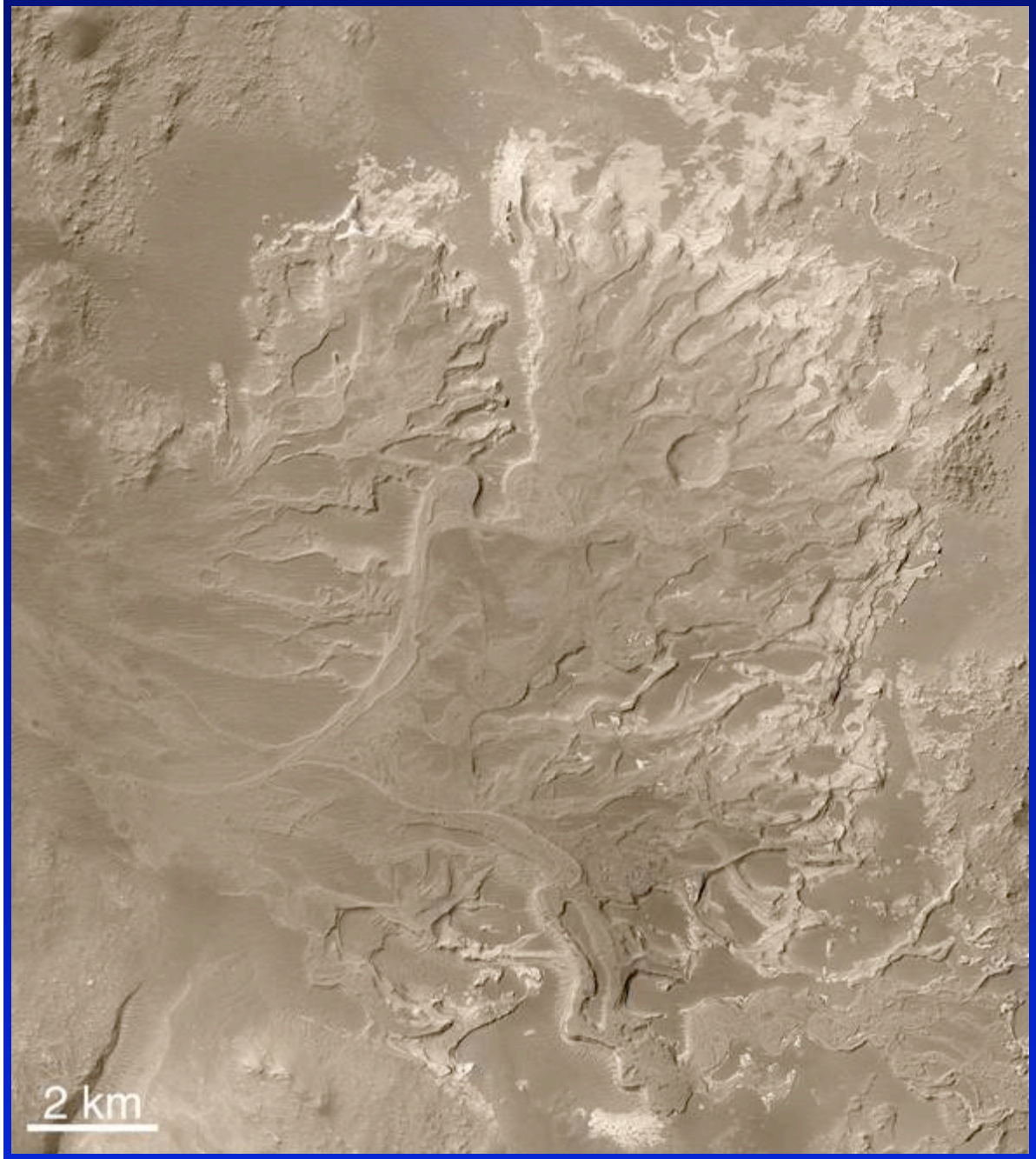
The Eberswalde Crater MSL Landing Site with Emphasis on Depositional Setting

Juergen Schieber, IU
Mike Malin, MSSS

Eberswalde Overview



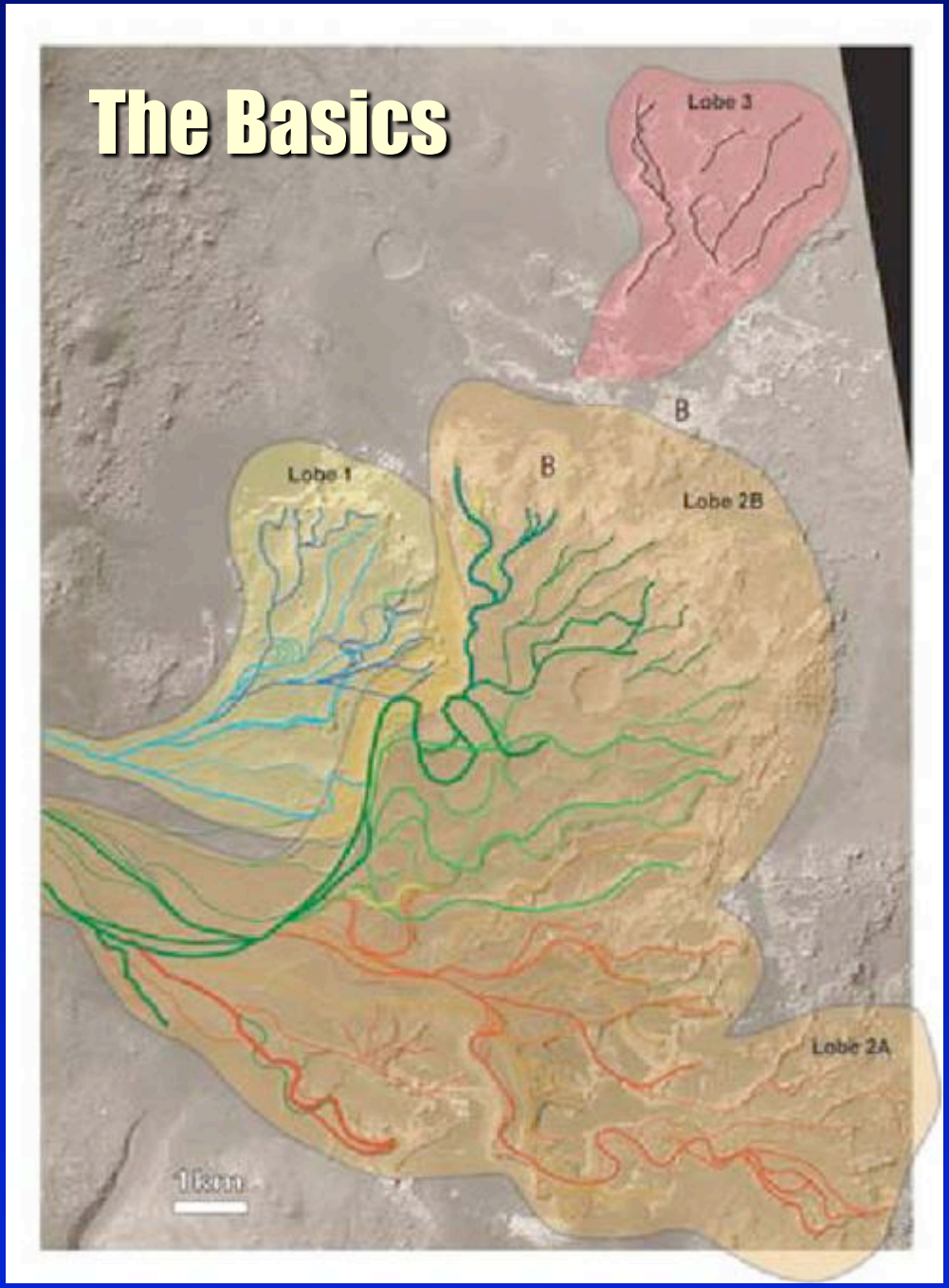

Source
Sink
CONTEXT:
- Crater older than Holden
- Partial fill by Holden ejecta
- Deposition of deltaic and
lacustrine strata
Holden



Eberswalde Delta

- Poster child of Martian deltas
- A series of sediment lobes building out into a crater basin
- Intense interest by planetary and terrestrial geologists
- Multiple publications from sedimentary geologists with extensive experience in terrestrial deltas

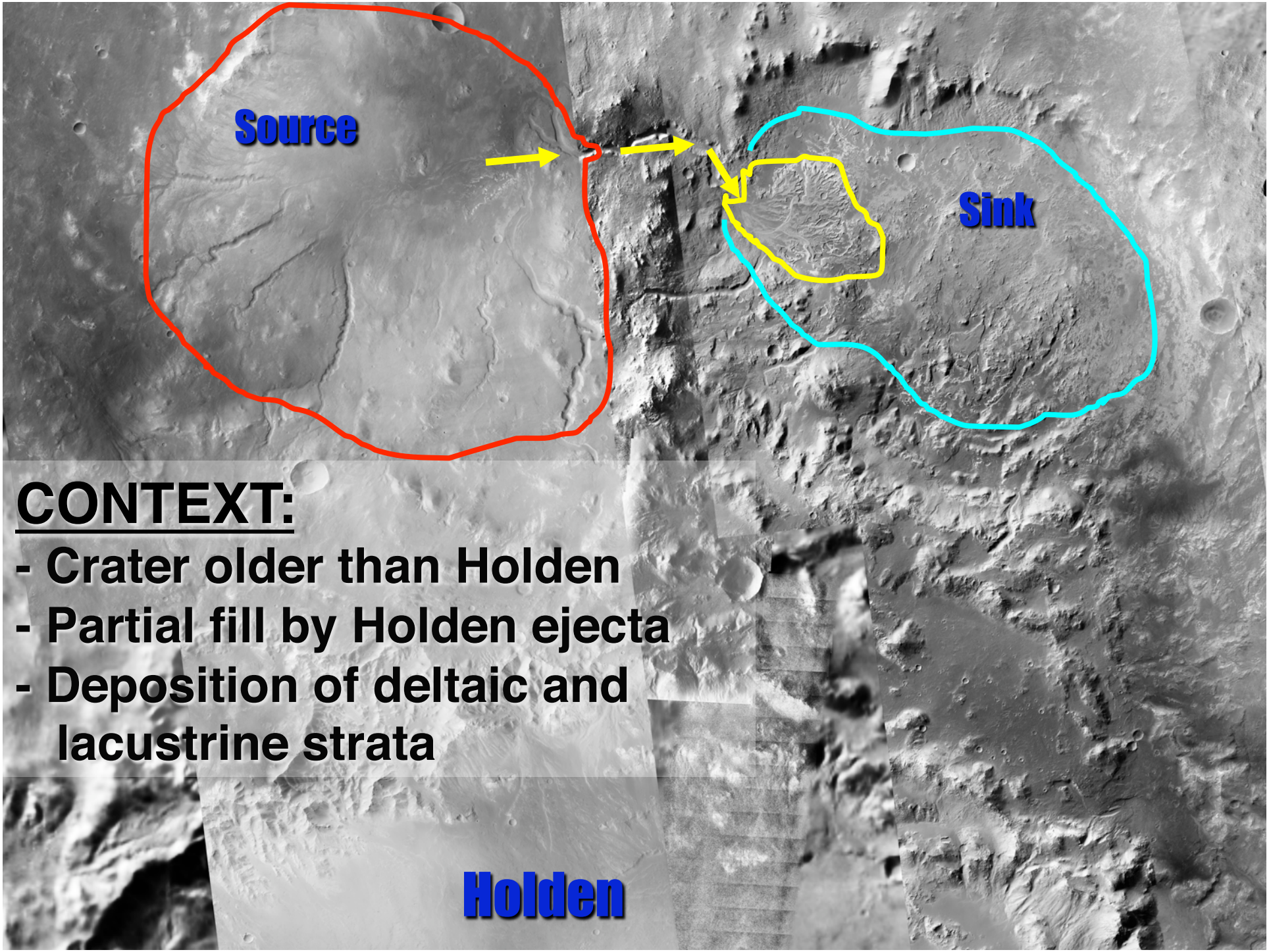
Lake Baikal near Selenginsk



- Multiple Delta Lobes
- Noachian age
- up to 150 m of sediment
- 6-30 km^3 sediment vol.

- minimum duration estimates, 10's to 100's of years (Jerolmack et al., Lewis & Aharonson)

- by comparison to terrestrial analogs, sedimentary record more likely ranges from 150, 000 years to several million years (Bhattacharya et al.)


Source
Sink
CONTEXT:
- Crater older than Holden
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- Deposition of deltaic and
lacustrine strata
Holden

Context

- Preserved Source to Sink Continuity
- Rich and Detailed Geologic History
- Mapping by Pondrelli et al. 2006/2008
- *Brief approximate history:*

1) Noachian crater formation
2) Holden ejecta deposited into crater
3) Fluctuating water levels in crater lead to localized channel formation and deposition of layered fine sediment on crater floor
4) Deep lake formation, large delta advance, and deposition of distal fines
5) Finally, sudden shut down of hydrologic system (lake gone and no dissection)
6) Later exhumation, most likely eolian

Diversity

- *Within Landing ellipse:* megabreccia, layered lacustrine fines, sinuous, anastomosing, and branching channels
- Full exposure of delta sequence, fluvial sediments

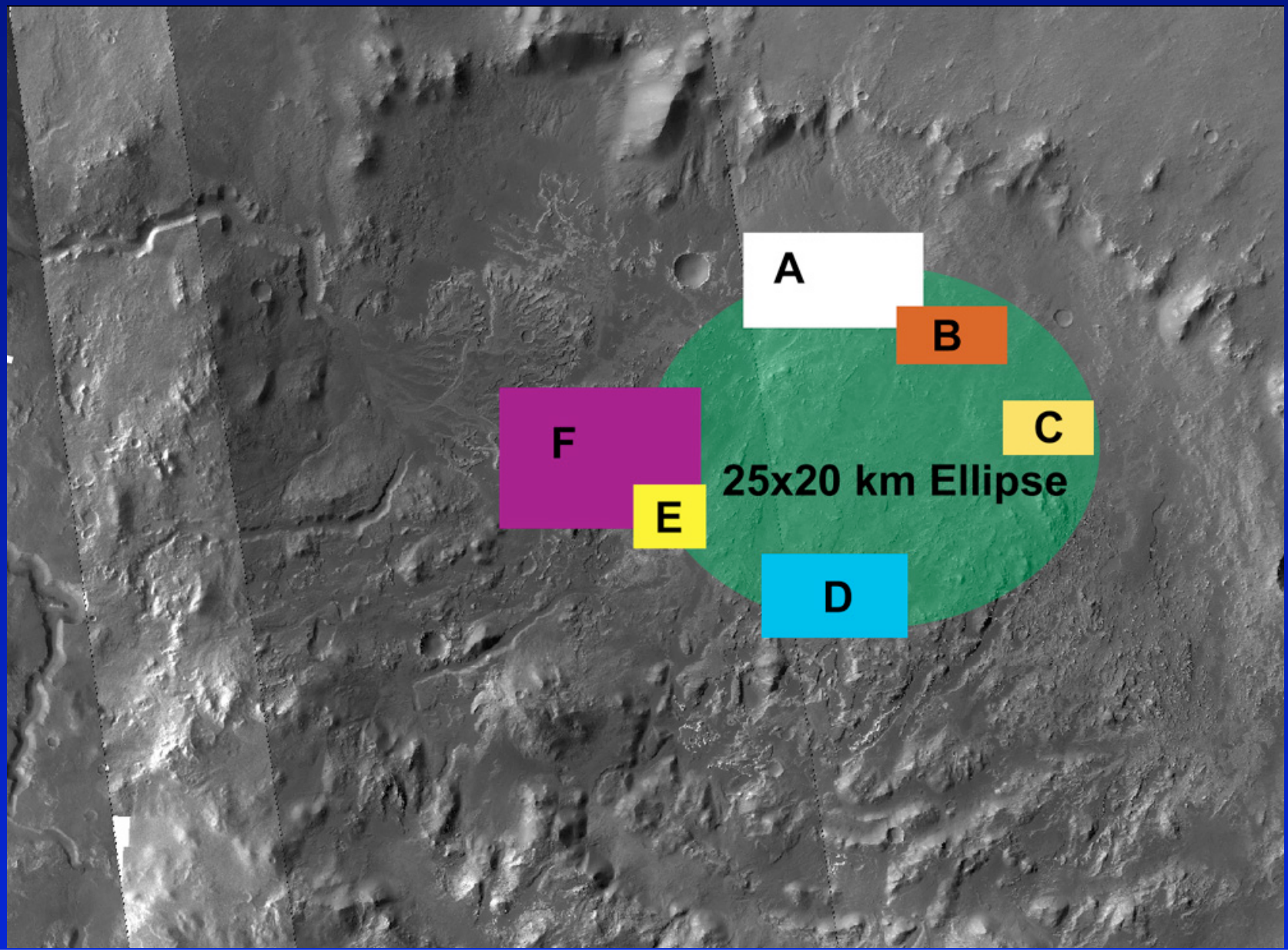
Habitability

- Lots of water involved in deposition
- numerous thin extensive sedimentary layers

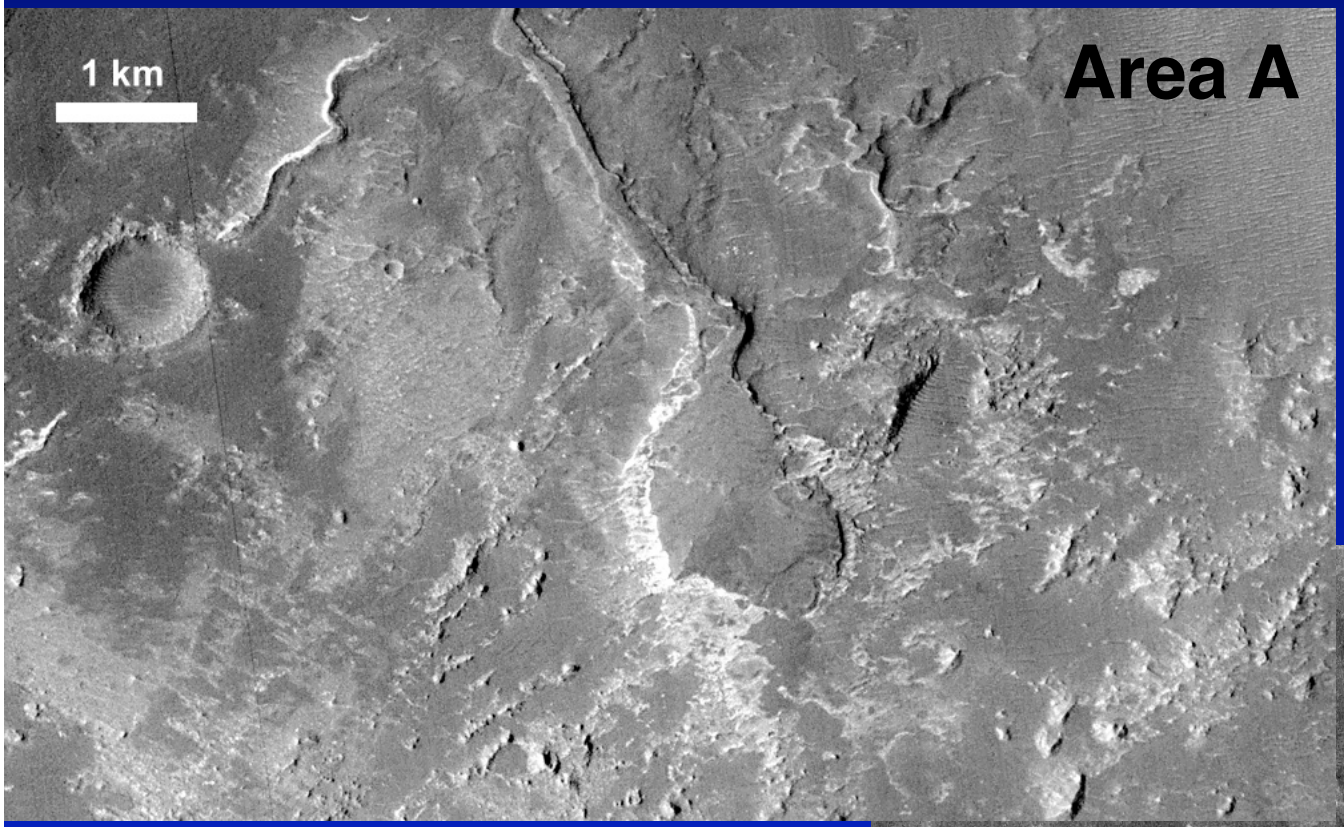
Preservation

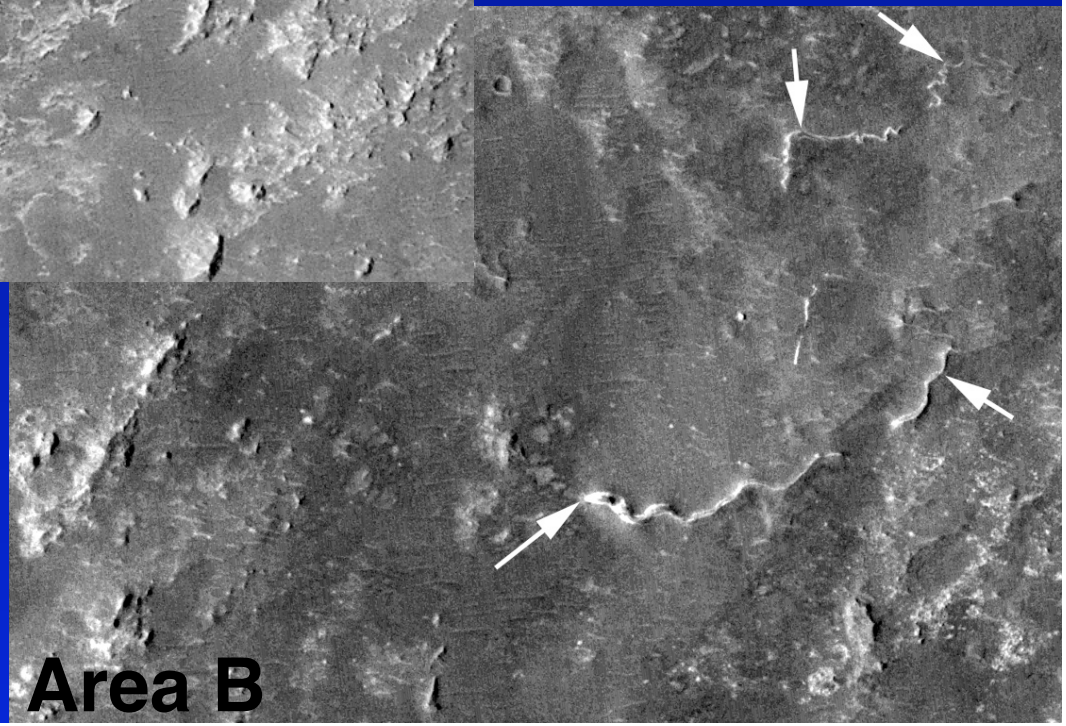
- Deposited into standing water of lacustrine basin
- Limited circulation in deep basin
- Deposition of distal fines
- Extensive and diverse phyllosilicates (see talk by Milliken)
- Modern eolian erosion provides access to unaltered materials

Opportunities within the Landing Ellipse



Opportunities within the Landing Ellipse

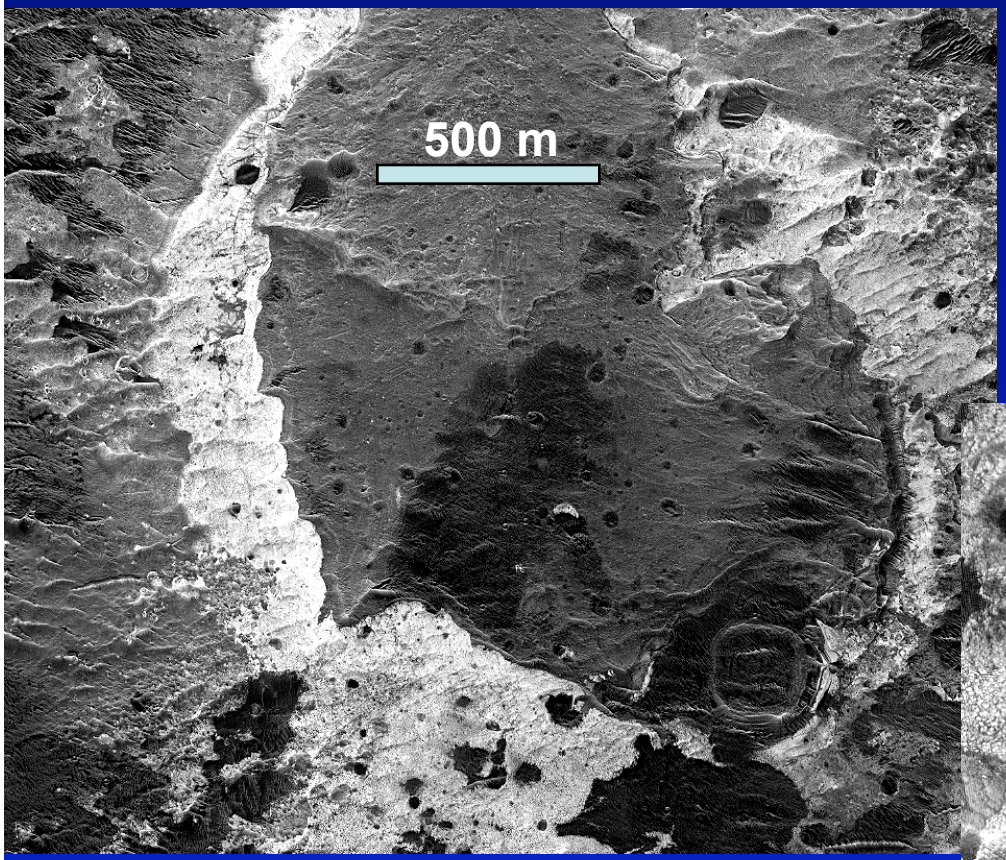




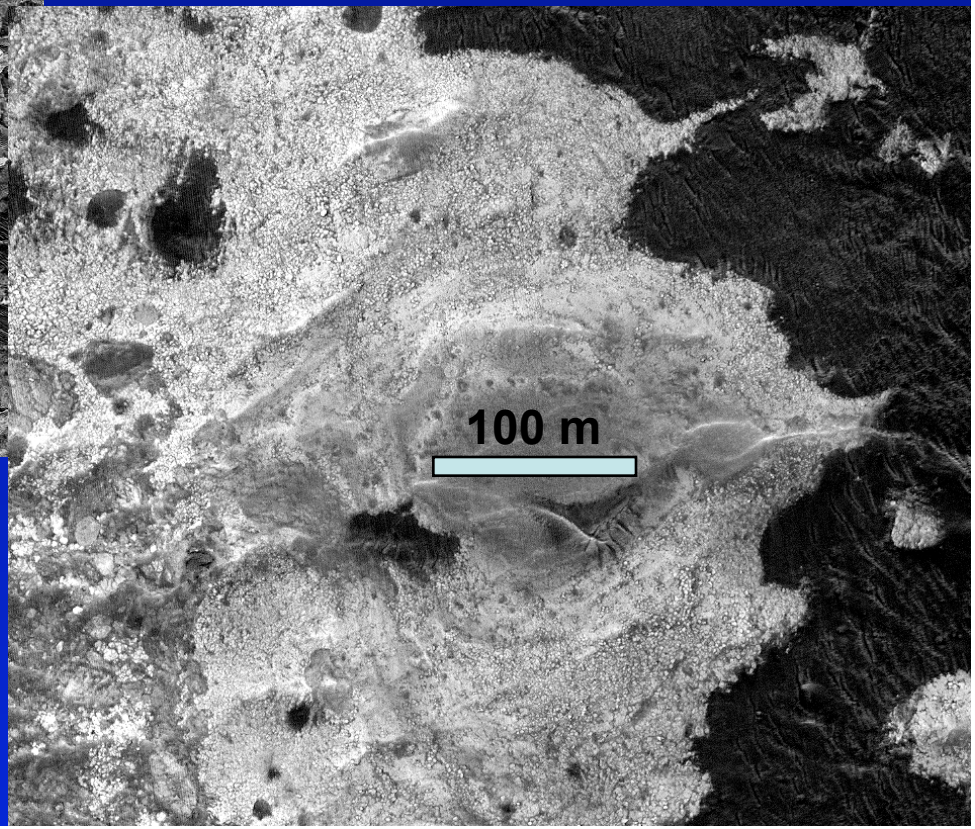
Inverted sinuous channels

Depositional lobes

Light toned layered rocks in Area A with Clay mineral signature (see Milliken presentation)

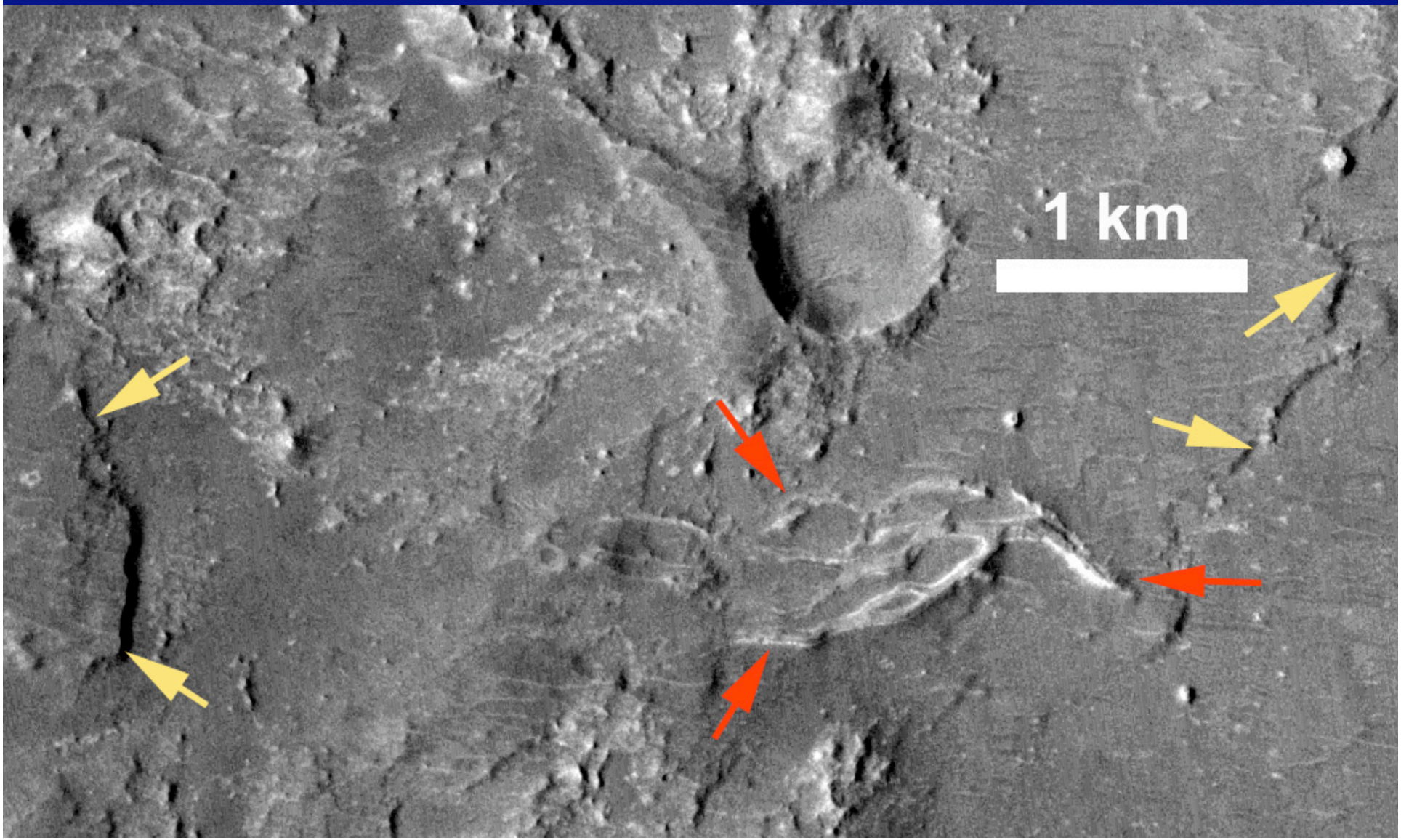


Many areas within ellipse show outcrops of this type of rock



AREA C:

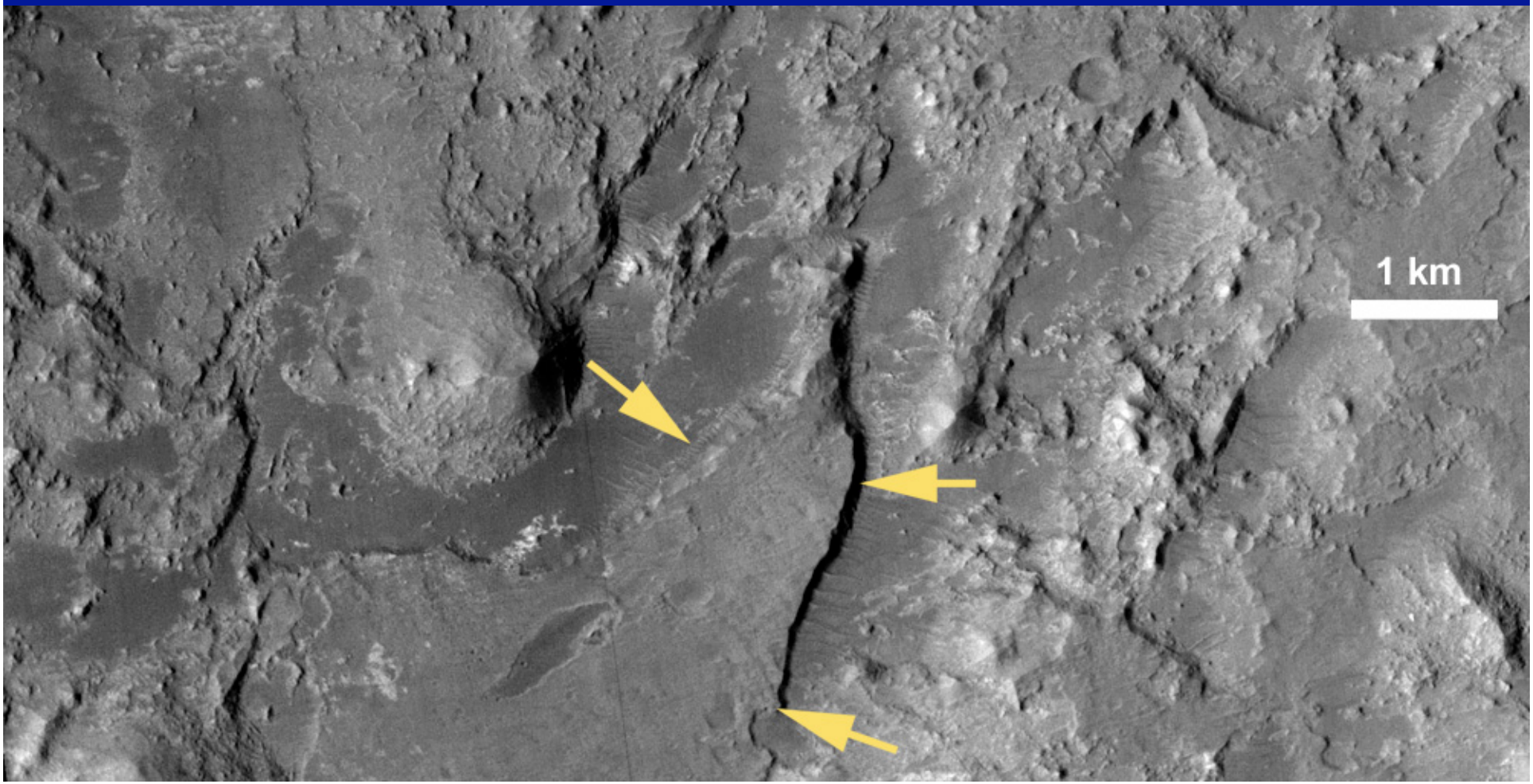
Exhumed multithread channels (red arrows) – fluvial, on hillslope
Exhumed from lacustrine blanket deposits (delta bottomset) – precedes main delta
Escarpments (yellow arrows) of lacustrine deposits



AREA D

Mesas of flat lying layered deposits, light toned, clay bearing (arrows)
- **Contiguous with light toned deposits south of ellipse**

Lacustrine distal delta deposits (bottomset), Condensed section, clays, potential for preserved organics



Megabreccias outcrop in several areas

Overlain by deltaic deposits in NW section of crater

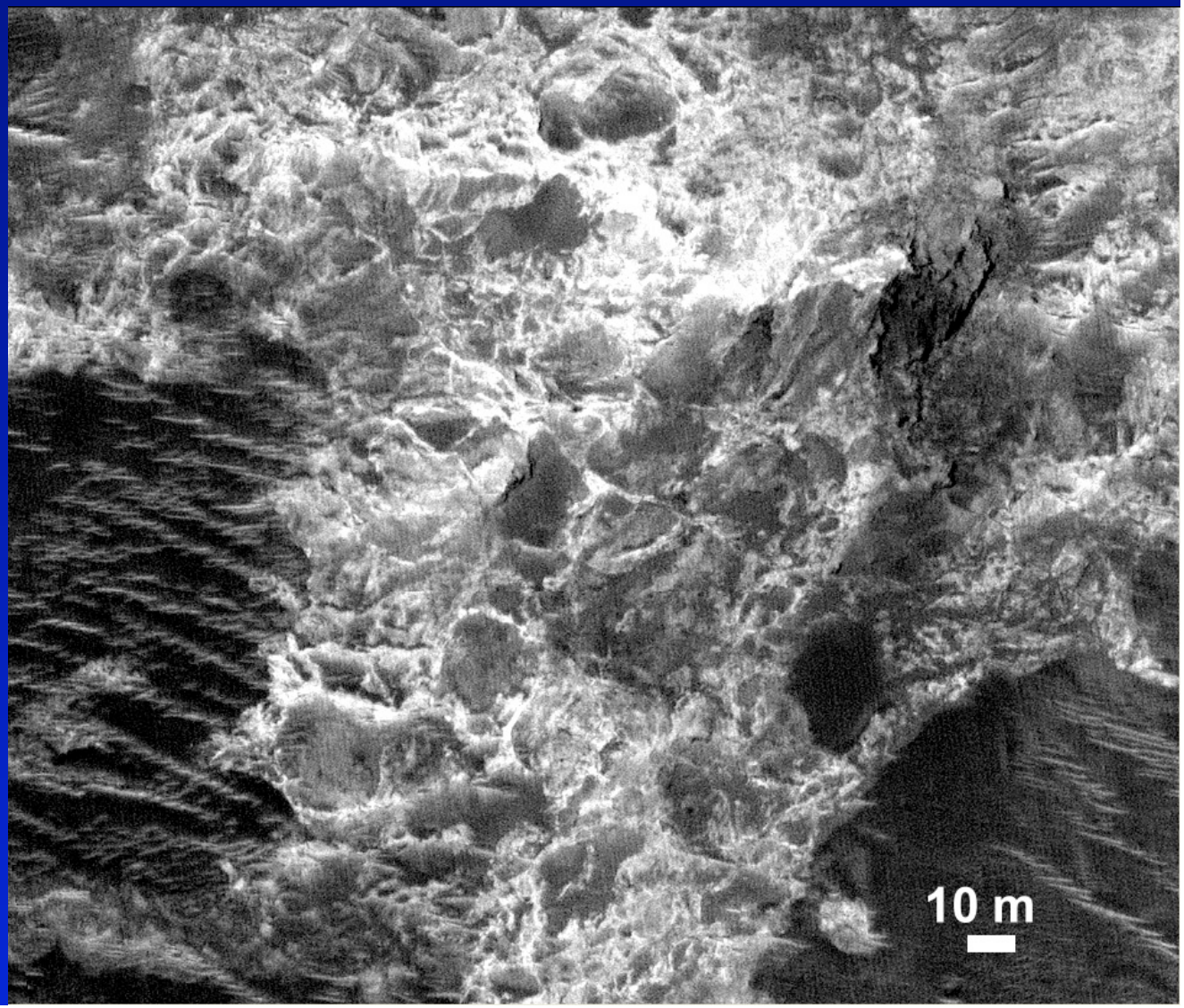
Occur in Center of Ellipse and in

NE sector of Ellipse in Area B

These are interpreted

as Holden ejecta

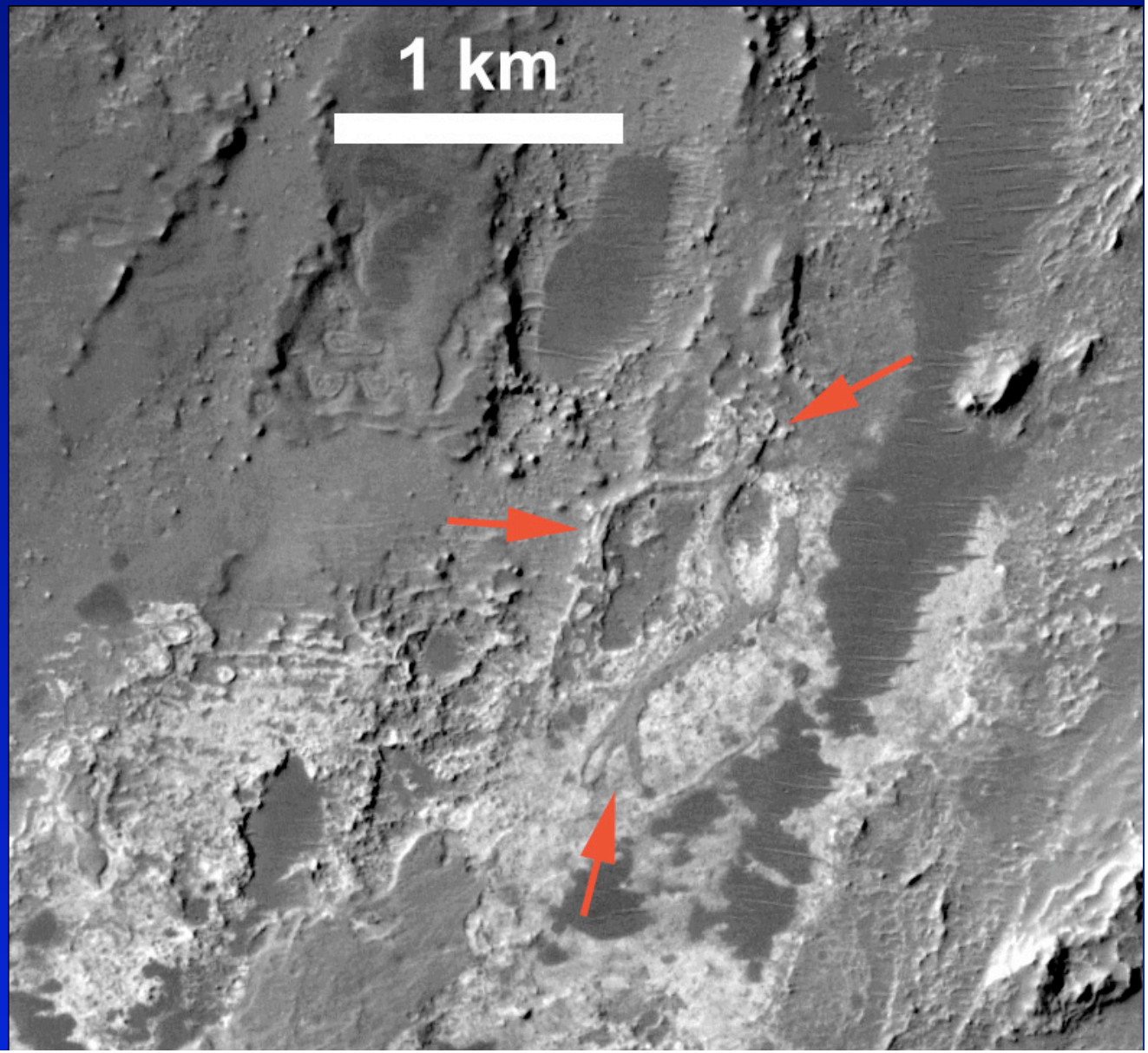
Allow the sampling of a wide range of lithologies without much driving



Likely Holden Ejecta

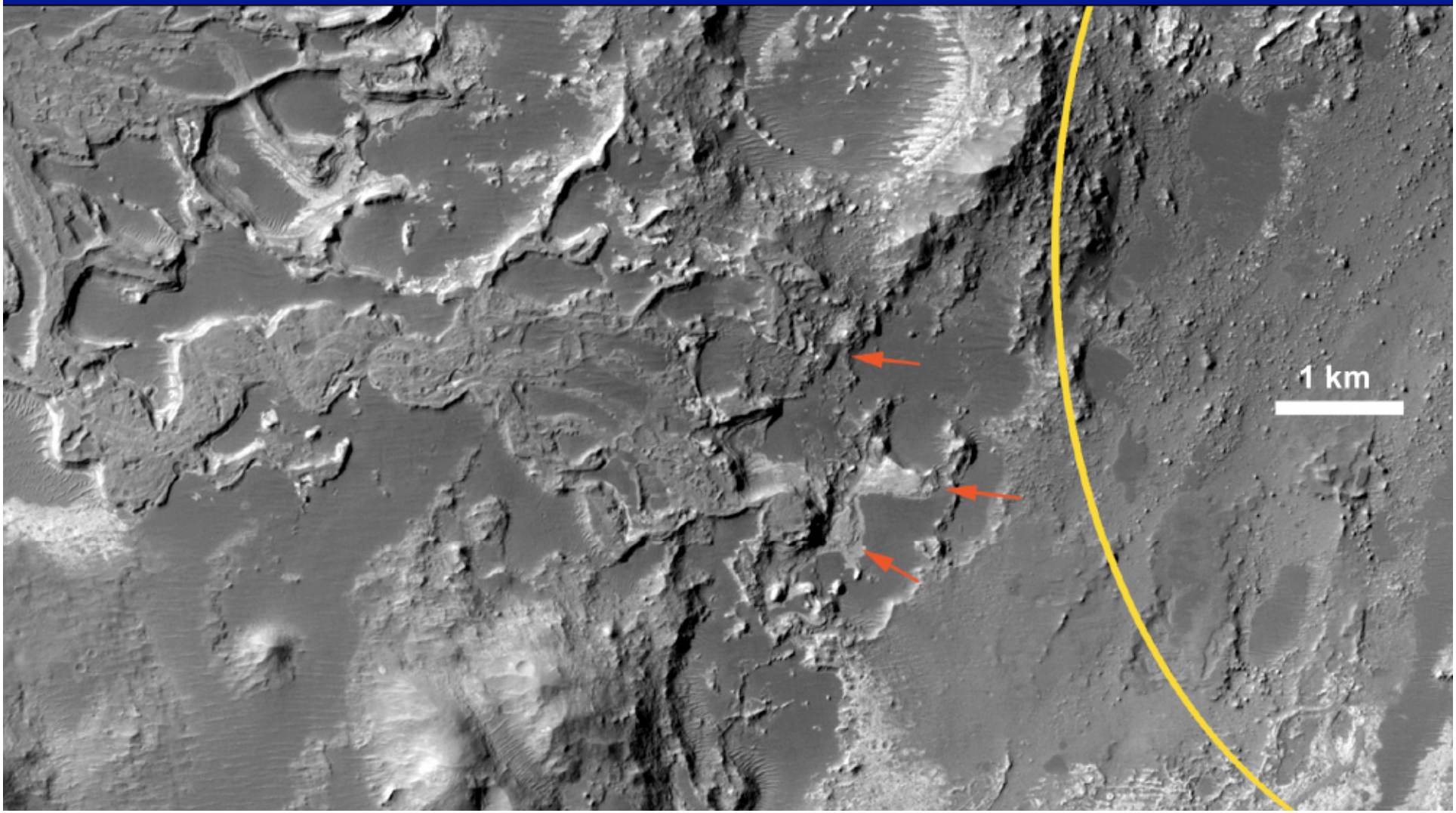
AREA E

Channels, anastomosing and/or branching (arrows). Exhumed from underneath light toned distal delta deposits (with clay signature)



West Ellipse (Area F) – going for the gold

- it will take only a short drive to access the main delta deposits
- the basal portions of the deltaic succession
- the clay rich bottomset deposits
- can be accessed by rover (red arrows)



Ellipse Summary

The Eberswalde ellipse contains numerous fluvial features
anastomosing, sinuous, branching channels

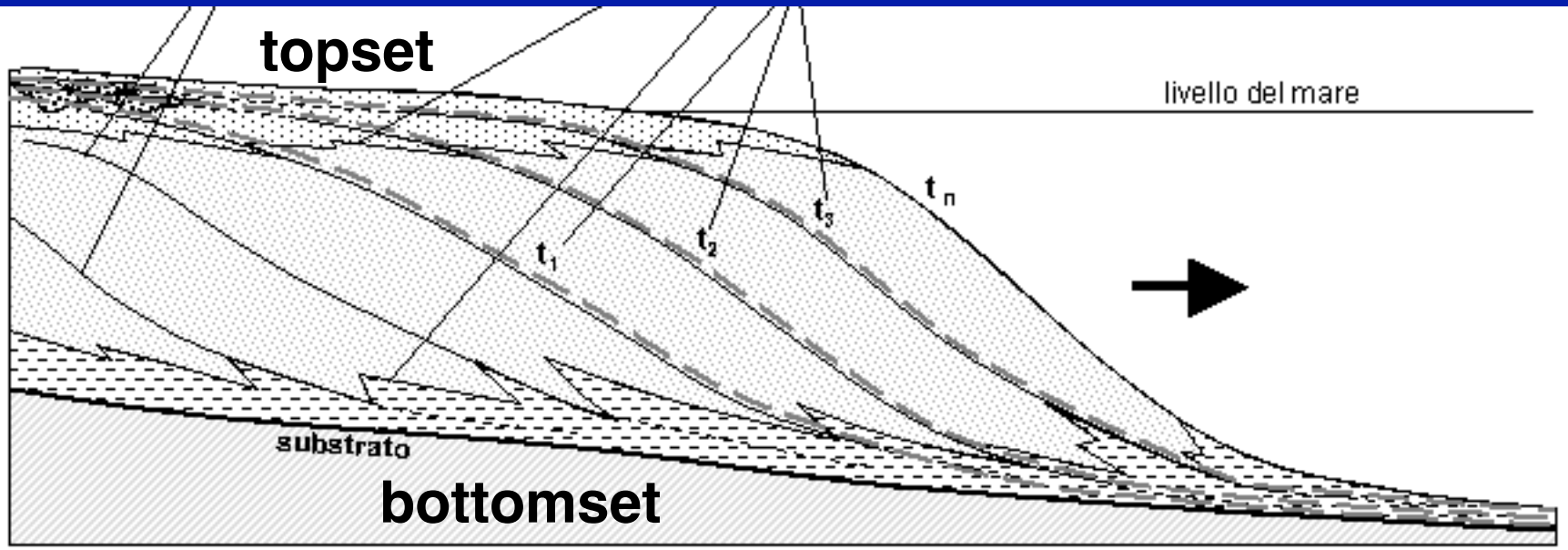
Clay mineral signatures are widespread and associated with light toned deposits that at least in part are the distal deposits of the main delta

The rover will have access to a large variety of deeper crustal lithologies in outcrops of Holden ejecta

The MSL objectives can be addressed immediately after landing and without leaving the ellipse

Exceptional Features

- Eberswalde is a rare Martian fluvio-lacustrine site with preserved Source to Sink Continuity
- The only site where deposition into a body of standing water is strongly supported by orbital data
- The implications of deposition into standing water is decreasing transport energy basinwards, accumulation of coarse sediment in the topset of the delta, and deposition of the finest components in the bottomset that extends far into the basin

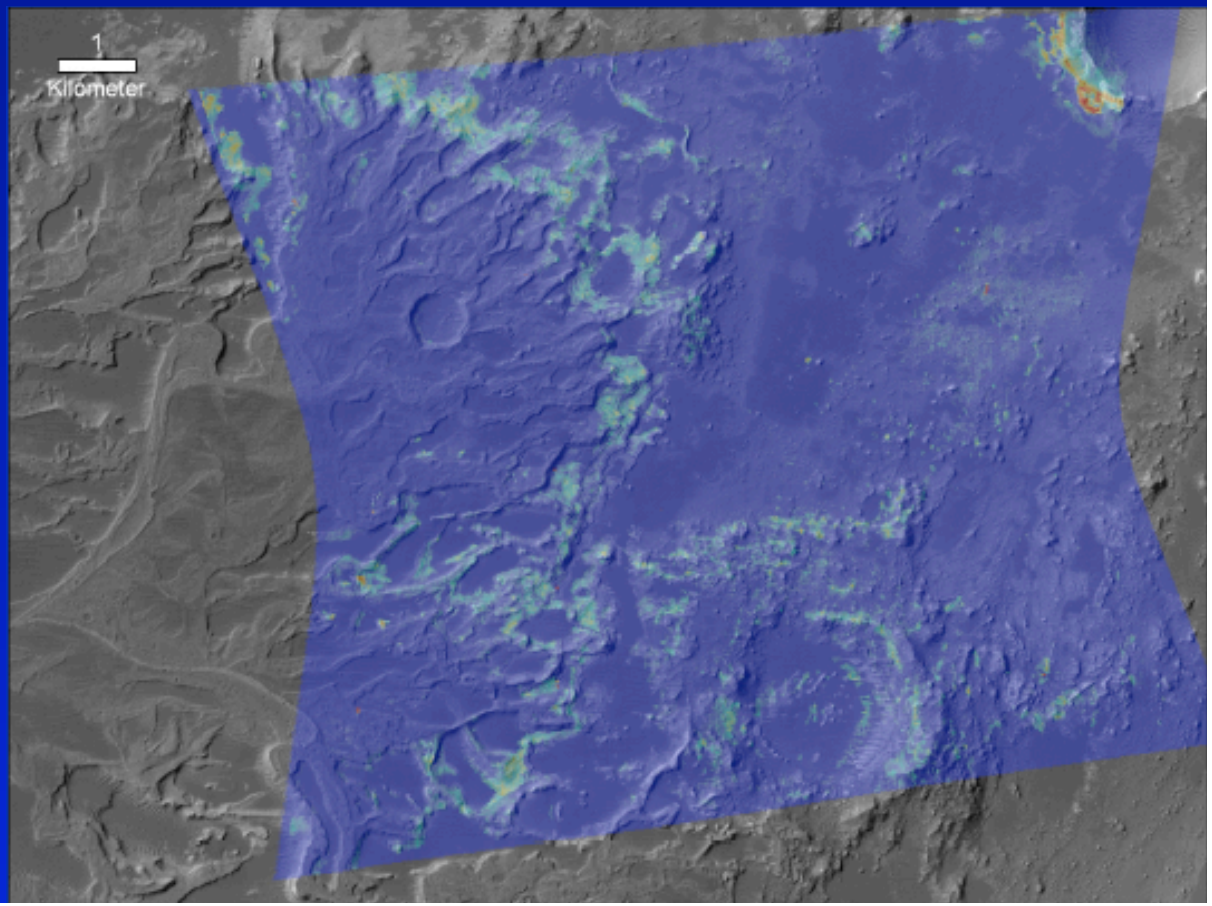


Condensed section, potential of organic matter enrichment

The Clay Mineral Story

- The Crism Data will be discussed in detail by Ralph Milliken later this afternoon
- Fundamentally, he will show that clay occur in many areas of the crater floor and the ellipse
- As well as in the basal, and more fine grained portions of the deltaic succession

Many areas in crater and ellipse with high preservation potential for organic matter



The Chemical & Mineral ID Capabilities of MSL

Chemin and ChemCam will greatly enhance analysis and science return from well defined sedimentary sucessions

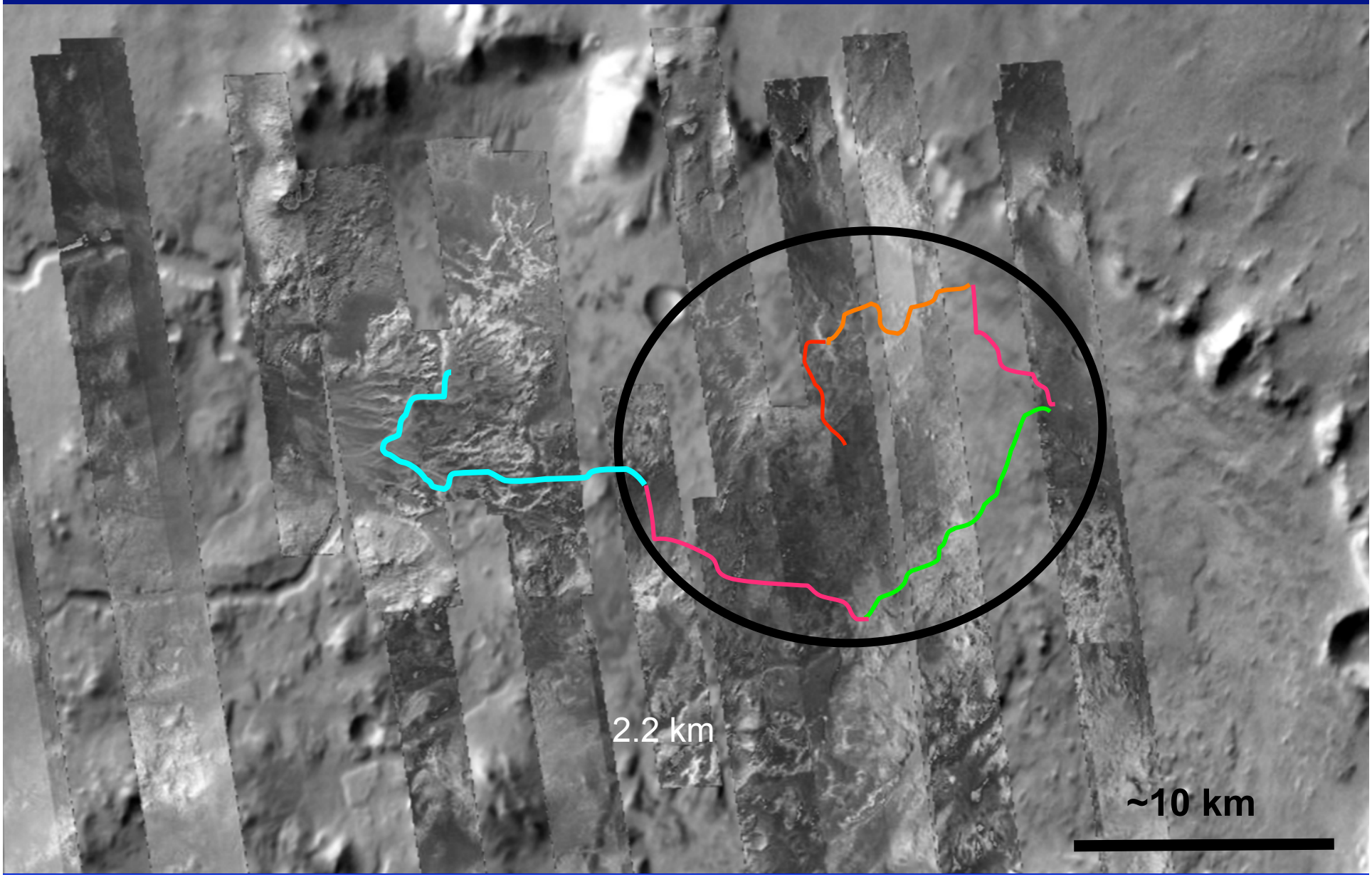
for example:

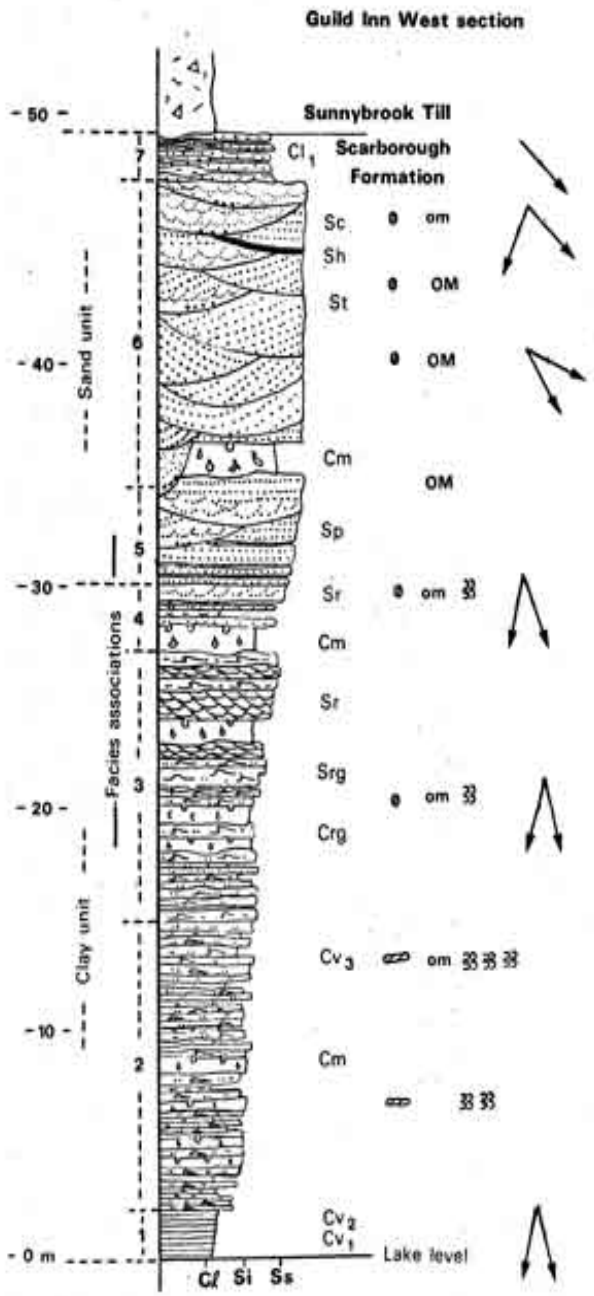
- Detect stratigraphic units with high clay mineral contents as prime targets for SAM (optimize search)
- Acquire time series of compositional change that relate to changes in weathering intensity
  clay mineral change
  detect climate-induced variability
  mineral ratios
  changes in erosion rates in source region
- Identification of Provenance (Source – Sink)
  ID changes in provenance
  possible reorganization of fluvial system

--- These capabilities come to bear much more strongly in a well defined sedimentary succession

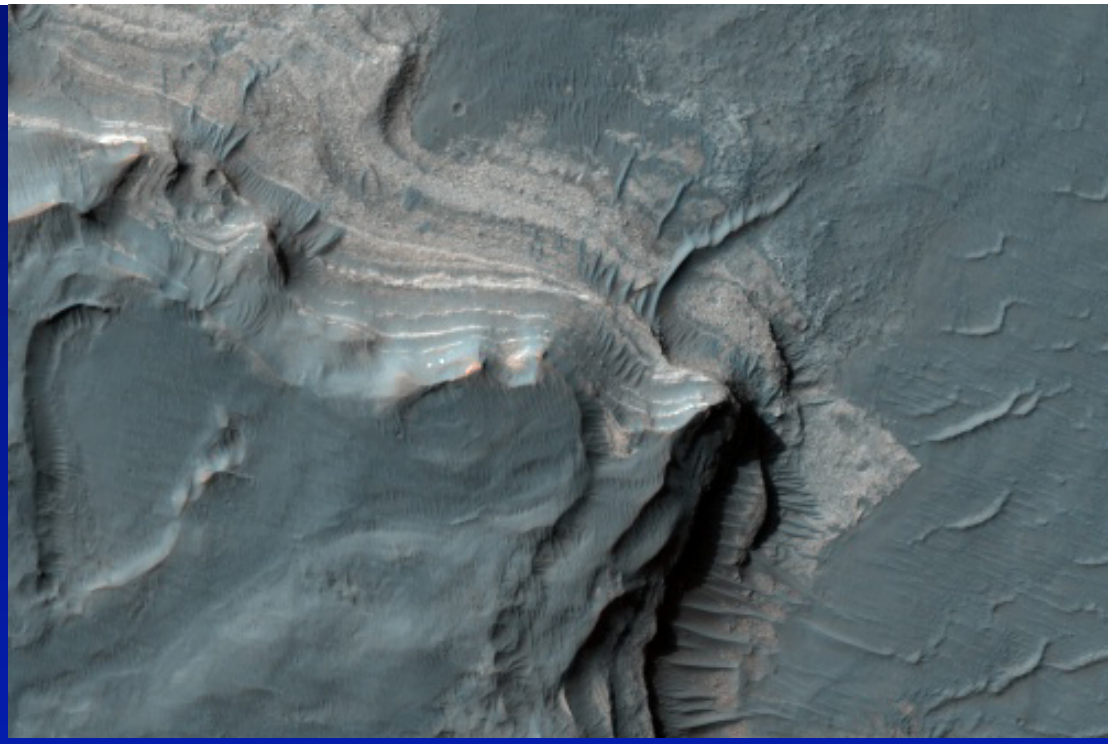
--- Greatly enhances abilities to understand geologic history from stratigraphic record

A Notional MSL Traverse





Schematic of Guild Inn West section showing facies associations.



Question: How do stratigraphic sequences exposed in cliffs at Eberswalde compare to deltaic successions on Earth?

Are they also coarsening upwards successions?

Mastcam telelens can provide the necessary observations

Summary

- In the Eberswalde Basin, sedimentary rocks that likely represent a wide range of depositional environments associated with aqueous activity are preserved and accessible
- These were clearly habitable and there is ample preservation potential in many locales
- Eberswalde is already so well studied that next generation questions are currently being addressed, such as rate of discharge, transport competency, rate of sediment accumulation, longevity of system, what kind of delta was it ?
- There are lots of competing ideas and many opportunities for hypothesis testing
- Eberswalde is a site with a very rich assembly of features that address MSL objectives

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- Rich and Detailed Geologic History

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